SUBJECTIVE COMPARISION OF OPTICAL INTEGRATION OF MONO SHADE TECHNIQUE AND DUAL SHADE LAYERING TECHNIQUE OF COMPOSITE RESINS.

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CERTIFICATE

This is to certify that this dissertation titled “**SUBJECTIVE COMPARISION OF OPTICAL INTEGRATION OF MONO SHADE TECHNIQUE AND DUAL SHADE LAYERING TECHNIQUE OF COMPOSITE RESINS”** is a bonafide record of work done by **Dr. Abinaya .K** under my guidance and to my satisfaction during her postgraduate study period between 2010 – 2013. This dissertation is submitted to THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY, in partial fulfillment for the award of the degree of Master of Dental Surgery in Conservative Dentistry and Endodontics, Branch IV. It has not been submitted (partial or full) for the award of any other degree or diploma.

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CONTENTS

ABSTRACT

SUBJECTIVE COMPARISION OF OPTICAL INTEGRATION OF MONO SHADE TECHNIQUE AND DUAL SHADE LAYERING TECHNIQUE OF COMPOSITE RESINS.

BACKGROUND: The availability of multiple resin systems leads to an inherent confusion among clinicians as to their usage and potential, therefore often not realizing or applying them in an ideal situation. A study in perspective was necessary to obtain the best solution in each scenario and this study highlights the advantages/disadvantages with various resin composite systems.

AIM: The aim of this study was to compare the optical integration of single shade technique and dual shade technique of composite resins subjectively.

MATERIALS AND METHODS: 36 extracted teeth having B2 shade were selected and a Class IV defect was simulated involving mesio incisal edge. Composite materials from 3 different manufacturers were taken (12 teeth in each) Viz: 3M ESPE, Coltene /Whaledent and Dentsply. From each manufacturer 2 composite brands were taken according to techniques used, one for single shade technique and another for dual shade technique. Groups were classified as **Group 1**: Ceram –X –Mono M2 (Mono Shade, Dentsply), **Group 2**: Ceram –X –Duo D2 +E1 (Dual Shade, Dentsply), **Group 3:** SYNERGY NANO FORMULA –B2/A2, (Mono shade, Coltene/Whaledent), **Group 4**: SYNERGY D6 universal duo-shade Nano composite- DENTIN-A2/B2 + ENAMEL – UNIVERSAL (Dual shade, Coltene/Whaledent, Altsatten/Switzerland), **Group 5**: Filtek Z250-B2, (Mono shade, 3M ESPE) and **Group 6**: Filtek Z350 XT- B3 body shade + B2 enamel (Dual shade, 3M ESPE). Teeth were restored accordingly and stored in distilled water to rehydrate for 2 weeks. Photographs were taken under four different light sources (natural day light, white light, yellow light and UV light). Five independent evaluators scored each photograph using Modified EVRSAM score. Mean scores were analyzed with One- way ANOVA (composite resin brands under different light conditions) and Student t -test (between the different composite resin brands).

RESULTS: Group 1, group 5 and group 6 had more esthetics and appealing match when compared with group 2, group 3 and group 4, which explains mono shade technique, is better when compared with the dual shade technique.

CONCLUSION:

Single hue system achieved better optical integration than multiple hue systems. Mono shade technique is better than dual shade technique where more time is needed when using more advanced dual shade systems compared with simple systems.

KEYWORDS: Composite resins, Dental esthetics, Dual shade layering, Modified EVRSAM, Optical integration, Single shade.

Introduction

‘**A smile is a curve that can set things straight**’. It is very often, the first focus and starting point to gauge a person’s appearance and beauty, that relates to every aspect of the environment, as well as to physical appearance. It is definitely considered a major vector in professional or personal achievement, bringing esthetic and cosmetic dentistry into sharp focus. Recreating a perfect smile is in the skill and responsibility of the dentist.

Although ceramics of various kinds have been introduced in today’s market, which provide ideal characteristics, they may not be economically viable for every patient[48]. It is in this circumstance that we fall back on composite resins which has made its comeback into dentistry in a big way. This approach reflects a contemporary attitude towards restorative dentistry, which systematically favors the selection of the most conservative option, without compromising biological, functional and esthetic integrity. Composites are usually applied to replace decayed or missing tooth structure in a more conservative manner, which requires less tooth preparation. For these reasons, composite resins currently occupy a prime position among restorative materials as they typically offer excellent esthetic solution and acceptable longevity at a lower cost than equivalent ceramic restorations. They are totally inexpensive to the clinician as well as to the patient[15].

Composite resin restorations must match the surrounding dentition for **hue, chroma, value, translucency, opacity, fluorescence and opalescence**[15]. This can be achieved with one or several shades, depending on the composite system. Irrespective of this, the same shade selection and light physics principles apply, with the difference being whether this must be repeated for several shades that will blend or whether one shade can be found that meets all requirements and blends in with the surrounding dentition. Translucency and opacity are major factors to be considered in shade selection. If a shade is selected that does not mimic the translucency and opacity of the tooth, it will be obvious and will not blend. Composite resins also exhibits **goniochromism**[30], i.e., the ability for its color to be perceived differently depending on the angle from which it is viewed. A recent study examined the effects of translucent multilayering as well as the placement of fibers at different angles within composites and found these did have a goniochromatic effect[10]. In addition, the size of the restoration has been found to influence the blending effect of the composite to the surrounding tooth[8].

From a practical perspective, there is a need for composite resin systems that offer the ability to provide esthetic restorations using only one shade. Single-shade restorations are simpler and quicker to place. Such composites should be able to blend in with the surrounding tooth structure through a **chameleon effect**, such that the gradation from different areas of the tooth structure to the restoration is not obvious and results in a natural-looking restoration. More esthetically demanding clinical situations can require a dual-shade or multilayering technique to mimic the adjacent tooth structure[44].

In direct composite layering, the thickness[51] and coloration of dentin and enamel are of primary concern. Recognizing the distinction in thickness[26], color and morphology of natural dentin and enamel, it is necessary to replicate these histological tissues in composite restorations[10]. This requires the use of composite formulations that are optically similar to each layer and sculpting these materials in a way that replicates the morphology of each layer in the area being restored. This logical, intuitive methodology has been deemed the "Histological Layering Technique"[37] also called as "anatomic build-up technique"[7], the "trendy three-layer concept"[15] and the "natural layering concept"[17] by various authors[16]. A variation in hue, value, chroma and translucency render the tooth polychromatic[19]. The dentin imparts all the colors to a tooth (i.e. hue, value) while the enamel functions as fibro optic structure that conducts light through its rods to capture the underlying color of the dentin (value) [49,19]. To achieve this a good shade matching is required. When using a composite system, the recommended shade guide must be used to ensure the best match possible in the final, polymerized composite compared to the surrounding dentition (or other restorations) [30].

But till date no studies have compared the optical integration between single shade composite technique with a layering technique. Hence the purpose of this study is to compare the optical integration of mono shade technique with dual shade technique of composite resin.

Aim and objective

The aim of the current study was to compare the optical integration of mono shade technique and dual shade technique of composite resins subjectively.

Review of literature

Fahl et al (1995) [19] described in detail the protocol for predictable restoration of anterior teeth with composite resins. They discussed on the origin and development of composite resin along with its histologic and optical consideration. They described the restoration sequence of cervical, middle and incisal thirds with materials best suited for each third of tooth along with aids to create the intricate refinement of hue, chroma and value. The authors found that restoration of cervical third requires a resin with resiliency; middle third with a resin having increased strength and incisal third with a resin having polychromatic characteristics.

Vallittu et al (1996) [48] conducted a study to determine attitudes of different groups of patients in Eastern Finland towards the appearance of their teeth and to consider the results from the psychological point of view. A questionnaire that included six background variables namely sex, age, dwelling place, professional education, occupation and respondent's upper font teeth and 13 additional statements concerning tooth appearance on a scale. The patients were asked to answer the question anonymously. Based on the results, authors concluded that appearance of the teeth was found to be more important to women than men and younger patients with higher level of education expressed a greater preference for white teeth than older patients.

Vanini (1996) [49] described in detail about the dimensions of light and color in anterior composite restoration. He highlighted the importance of interaction between light and the hard tissue structure of the tooth as compared to the interaction between light and composite restorative materials. He emphasized on the importance of "chromatic map" of the tooth, which has hue, value and chroma, low translucency dentin composite usage, high translucency enamel composite usage and anatomic build up technique for the reproduction of natural anatomy and color characteristics exhibited by natural dentition with composite resin.

Dietschi (1997) [15] described various indications of composite restorations in the anterior area with certain reference criteria such as biologic concern, optical attributes, spatial reference and restoration integration. He also explained the basic properties of composite resin restoration. With these references he presented a case report, in which multilayering technique was used, which offered an appropriate fluorescence and opalescence, as well as good shade matching opacity.

Dietschi (2001) [16] reviewed and described the current main shading concepts, which includes various layering techniques namely classical 2-layer concept, classical 3-layer concept, modern 2-layer concepts and trendy 3-layer concepts. He also described their potential for creating natural esthetics and provided guidelines for application of various concepts.

Lee et al (2001) [28] conducted a study to determine the color distribution of new white and translucent shades compared with those of shade guides and to determine the influence of measuring mode, SCE (Specular component excluded) Vs SCI- (Specular component included) on the color of shade guides and new shades of resin composites. Color measurement of labial portion of shade guide tabs (VITA and Chromascop) white, translucent and conventional shade of two brands of resin composites were measured according to CIE L*a*b* color scale using reflection spectrometer with both SCE and SCI mode. The values were compared between the composite resin and shade tabs. The color of resin composite was located on the low CIEa* and CIEb* (blue and green range) when compared to shade tabs which was in high CIE L*a*b* (yellow-red-ranges). The authors suggested for development of a new shade guide system, where shades are logically rearranged and new shades of composites are included.

Paul et al (2002) [38] assessed the shade matching between visual and spectrophotometerically performed selection of body tooth shade in human teeth. 3 different operators using VITA Classical Shade Guide did shade assessment in the middle third of maxillary central incisors for 30 patients. Spectrophotometric readings (CIE L*a*b) were calculated and compared between selected VITA classical shade tabs and human tooth. The results suggested that spectrophotometric shade analysis is more accurate and more reproducible when compared with human shade assessment.

Terry (2003) [44] illustrated the role of shade determination, shade mapping and use of composite resin for direct esthetic restoration in the anterior region. He suggested that contemporary composite resin restorations are often fabricated using incorrect guides that can compromise the final results. So, he fabricated a custom shade tab for predictable restoration using direct composite resin by using layered shades of polymerized resin. He concluded that custom fabricated shade tab might assist the clinician in replicating the natural tooth color.

Paul et al (2004) [39] conducted a clinical study to test the shade match of single porcelain-fused-to-metal (PFM) restorations with the adjacent dentition when the restorations were fabricated using either conventional visual shade matching system or spectrometric shade matching system. 10 patient's maxillary central incisors were included in the study. Visual shade assessment was done using VITA shade guide and the selected shade was subjected to spectrophotometric reading. Spectrophotometric value of individual tooth was also assessed. The color difference was then calculated. The author concluded that spectrophotometric shade analysis and communication of shade was better and more efficiently used for fabrication of PFM.

Blank and Latta (2005) [6] presented a new cut back, etch, bond and layering technique (CEBL) as an alternative to the free hand technique. They also conducted a study to evaluate the micro tensile bond strength obtained by using the above said technique and the influence of air inhibited layer on the micro tensile bong strength. The authors found that micro tensile bond strength was similar for both groups [(i.e.) with and without presence of air inhibited layer] and they concluded that this CEBL technique could be an alternative for the free hand layering technique when using multi shade composite systems.

Deliperi et al (2005) [13] presented a case report on restoration of class III defect using layering/ stratification technique with microhybrid resin based composites (i.e Vit-l-escence) in wedge – shaped increments. They also focused on photo polymerization process and understanding its potential and limitations.

Hassel et al (2005) [23] compared the clinical results of shade matching on the basis of finished restorations using a conventional shade guide system – Vita Classical and systematically analyzed shade guide system –Vita 3D - Master. Shades were recorded using the above systems from 49 patients receiving fixed ceramic restoration. The shade of final restoration was then compared intraorally with the residual teeth by both the patient and the supervising clinician. The degree of match was rated with the aid of visual rating scale ranging from 1 to 10. Clinical assessment of the restoration shades showed significant difference between the shade guide with a systematic design and that based on empirical value.

Kamishime et al (2005) [26] proposed a study to evaluate the inherent colors of resin composites used for the layering technique and the translucency of composite materials at various thicknesses. Translucency parameter was calculated with black and white backing and CIE LAB values of 2 different composite materials viz; Filtek Supreme (3M) and Gradia Direct (GC). Disks of various thicknesses consisting of 3 different shades (enamel shade, body shade, and opaque-shade) were made. They found that translucency increased exponentially as thickness was reduced-regardless of shade and opaque shade was less translucent than the other shades. The authors concluded that in the layering technique, it is fundamental to have an accurate knowledge about the translucency, materials and shades used.

Lee et al (2005) [29] proposed a study to determine the difference in fluorescence of layered resin composites with a color measuring spectrophotometer and to compare the fluorescence with that of human dentin. Spectral reflectance and color of five specimens made from each of five different brands of resin composite were measured over a white standard tile according to CIEL*A*B color scale relative to the standard illuminant D65. Human dentin was used as a control. The authors found that the dentin and 3 resin composite brands showed same fluorescence peak, which was around 440 to 450 nm, whereas the other 2 composite brands did not.

Adeyemi et al (2006) [1] compared the use of QLF with digital imaging in the detection and quantification of the development and removal of stains on the teeth. Two experimental phases tooth staining and tooth whitening, were conducted in vitro on labial ($12mm^2$) enamel windows of extracted bovine teeth using artificial saliva, chlorhexidine and tea solutions. The authors concluded that QLF showed a high correlation with digital imaging. They also suggested that the same technique can be used for detecting and monitoring tooth stains and tooth whitening in vivo.

Ardu and Krejci (2006) [3] described a layering technique based on biomimetic approach for class IV restoration. This simplified technique was based on a modified layering technique where palatal enamel and dentin masses were replaced with same quality of micro hybrid enamel and dentin shade composite along with a thin buccal enamel layer with micro filled resin composite. With this art of combination of resin composite materials, the authors found that this combination had better physical and optical characteristics similar to the natural tooth.

Dietschi et al (2006) [17] proposed a study to present a shading concept based on colorimetric L*a*b* and contrast ratio data of human dentin and enamel that represent innovative and more rational approach for the laying of anterior composite restorations. Extracted teeth of A and B Vita shade groups were sectioned in 2 different planes, such that enamel and dentin sections were obtained. Enamel and dentin samples of natural tooth and enamel and dentin shades of composite were submitted to colorimetric evaluation and the values were compared. They found that dentin contrast ratio had limited difference whereas enamel proved to increase in translucency with age (reduced contrast ratio).

Paravina et al (2006) [37] evaluated the blending effect of composite materials in relation to the size of the restoration. The design of the study was to observe the specimens which were made of 2 composites involving an outer ring made of Palfique Estelite (C2 shade) while the inner rings were made of Palfique Estelite and Esthet –X (A2+ B2 shades) for their blending effect. 6 observers using a 1-5 scale did visual color assessments. They concluded that good blending effect was seen PE (Palfique Estelite) A2 shades, while others yielded comparatively lower values.

Aguiar et al (2007) [41] evaluated the fluorescence of 10 different dental composites using contrast ratio to adjacent tooth structure. Restoration was done on 33 maxillary incisors using different composite materials. High definition images of the restored area and adjacent tooth structure were obtained both under white light of visible spectrum and UV light. The contrast between composite and tooth structure, expressed in absolute value, was analyzed through digital processing Matlab and Origin software. Based on the mean value obtained, the composites were ranked in four groups according to least fluorescence contrast ratio. The authors concluded that there was significant variation in the fluorescence between the composites and the natural tooth structure.

Bayindir et al (2007) [5] proposed a clinical study to determine and compare the coverage error (CE) of 3 different shade guide systems namely; (1) VITA Lumin, (2) Chromascop, (3) Vitapan 3D Master and (4) a combination of the 3 shade guide systems when selecting shades for anterior vital teeth in a selected population. Shades of maxillary central incisors, lateral incisors and canines of selected patients were assessed using 3 different shade systems. Spectral reflectance values of the tooth and shade system were also obtained by spectroradiometer. The coverage errors were then calculated with obtained CIE values. The Vitapan 3D Master shade guide system resulted with lowest coverage error when compared to other systems.

Blank (2007) [7] described a protocol/technique for restoring anterior teeth with composite resin from a histological perspective. He emphasized the fact that natural tooth contains 3 optically distinct layers and when viewed from histological perspective, dentin imparts the most significant amount of tooth's overall hue. Optically enamel is colorless which serves to modulate value with slight variation in hue. Histologically enamel is thinnest in the cervical third of the tooth allowing the darker dentin's color to show through. In middle third due to increased thickness of enamel, the hue and the value of dentin becomes lower. The incisal third being composed hugely of enamel takes on a myrid of optical and color diversely giving the dramatic "edge effect". Thus the author described a simplified layering technique of composite restoration in order to mimic this natural transformation of color.

Vichi et al (2007) [51] evaluated the influence of layer thickness on the final color of different composite shade's opacity in a laboratory set up simulating a two-layer stratification technique. From a single composite system (Point 4, Sybron-Kerr, Orange) four dentine shades (A1, A2, A3, A4) and 3 translucent shades were selected. Disks of 0.5 to 3mm thickness, with an increasing thickness of 0.5mm dentin shade and 0.5 to 2mm thickness of translucent shade were made. Combination of base and translucent material color was determined with a spectrophotometer. The results indicated that there was a color variation for each incremental build-up of dentin shade and this difference increased when the layer thickness of translucent material decreased. The authors found that the layer thickness and the proportion of thickness greatly influence the color perception in the final aspect of multilayer composite restoration.

Joiner et al (2008) [25] reviewed on tooth color and whiteness. They conducted a database search electronically on 'Medline' and 'ISI web of sciences'. Authors described and reviewed the current knowledge on color range perception of tooth color. The application of colorimeter within dentistry has permitted the measurement of tooth color in an objective way, with the most common color space in use being the CIE L*A*B. Overall by comprising different studies they found that there was a significant contribution of b* value as yellowness in natural tooth color.

Magne and So (2008) [31] evaluated the optical integration of 4 contemporary composite resin materials used for class IV restoration and the natural layering concept. Four different brands of composite materials were used which were namely: Miris 2, Gradia Direct, Enamel Plus HFO and Filtek Supreme Plus. Restoration was done on extracted incisors with class IV defect using natural layering concept with only 2 composite resin masses. The specimens were allowed to rehydrate for 2 weeks and was then photographed under standardized light conditions (direct, indirect and fluorescence). 6 evaluators scored the images using optical integration score. Authors found that Miris-2 obtained the highest score followed by Gradia Direct, Enamel Plus HFO and Filtek Supreme Plus. They concluded that single hue system was better than multiple hue systems.

Napadlek et al (2008) [35] reviewed and presented issue of color perception by human eye in connection with different techniques of dental color matching. They compared and systemized different technique of color matching to simplify procedure. They also compared the advantages/disadvantages of visual and various instrumental techniques with dental color matching.

Smith et al (2008) [42] assessed the reproducibility of a mobile non-contact camera based Digital Imaging System (DIS) for measuring tooth color under in vitro and in vivo conditions. In vitro study, image of dried tooth specimens were made by 2 different operators. In vivo study, 25 suitable subjects with normally aligned upper anterior teeth without restorations were selected. Images were taken for 4 consecutive days and 3 operators collected images of subjects in a randomized order to measure inter and intra operators variability. The authors concluded that this method was shown to be a reproducible means of measuring tooth color.

Chirdon et al (2009) [10] determined the effects of multiple translucent layers, the alignments of composite structures and specular reflecting backing. In this study they used composite filled with short E –glass fibers which were oriented in a random fashion, perpendicular or parallel to the surface using an electric field. A Minolta CS -100 colorimeter was used to measure the color at various angles. All these composite specimens exhibited goniochromatic mechanism. The authors concluded that teeth are naturally aligned composites composed of translucent layers. Gold backing was found to impart vital appearance to the restorations and this perceived that vitality might be related to goniochromism**.**

Caglar et al (2010) [9] compared the color parameters for resin composite and ceramic shade guide using a colorimeter and digital image method with illuminants at different color temperature (2700k, 2700 – 6500k, 6500k). 2 different resin composite shade guides namely Charisma (Heraeus Kulzer) and Premise (Kerr corporation) along with 2 ceramic shade guides Vita Lumin Vacuum and Noritake were used. Ten shade tabs from each group were subjected to colorimetric evaluation and CIE L*a*b values were obtained. Digital photographs were taken for the 10 shade tabs under standardized conditions. CIE L*a*b values were obtained from the images using Photoshop CS2 software. The color difference were calculated and found to be highly correlative. The authors suggested that digital imaging method could be an alternative to the colorimeter.

Chu et al (2010) [11] reviewed the current status of the dental color matching instruments and systems in vivo. They conducted a database research electronically on “Medline” from 1981 to 2010. The authors described about various spectrophotometers, colorimeters, digital cameras, imaging system and interpretations and application of shade analysis data. They also suggested that both instrumental and visual color matching method complement each other and correlate towards predictable esthetic condition.

Da Costa et al (2010) [12] conducted a study which compared various final shades of three different brands of resin composites over white backing (WB) and black backing (BB) and a layering technique (enamel over dentin composite) with the corresponding Vita classical Shade Tabs (VST). Composite disk specimen of enamel shades B1, B2, A1, A2 and dentin shades A1, A2 and A3 were made. The color of the VST B1, B2, A1 and A2, enamel disk and layering composite of all the brands were assessed using a colorimeter over WB and BB. The total color difference [lab={(L)+(a*ab)+(b*ab)}] between the VST and the corresponding resin was calculated. The results showed that there was poor color match between the composite enamel shades of all brands with VST against WB. Only a few layered composites matched the L*a*b* of the keyed VST. The authors concluded that composite shades do not match well to the vita shade guide tabs even when the layering technique is used.

Denissen and Dozic (2010) [14] proposed a study to develop and apply a digital procedure whereby tooth color could be matched to shade guide tabs on digital photographs. A shade guide was made with 1.5mm thickness, for computer-generated crown and bridgework, which was used for color matching. Digital photographs of the vestibular surface of the tooth with shade guide were obtained and photographs were analyzed using Photoshop CS2 software. The difference in color was calculated with CIEL*a*b values and was found to be up to 1.3%only. The authors considered digital L*a*b measurements on a photograph to be effective for matching the shade by the dentist and ceramist.

Ishikawa et al (2010) [24] conducted a case study to analyze the factors that influence tooth color determination. They also evaluated the process of interpretation of tooth color based on scientific color data using a novel dental spectrophotometer system. The Crystal eye (Olympus, Tokyo, Japan) dental spectrophotometer was used for tooth color measurement and analysis of bleached teeth. The authors concluded that use of a dedicated dental spectrophotometer allows the evaluation and measurement of color of tooth and also allows the laboratory technician to more precisely understand the bleached tooth shade.

Lowe (2010) [30] described the importance of esthetics using newer composites, newer adhesive systems importance of dental anatomy, physics of light and color and their influence on correct shade matching. He also focused on newer adhesive systems available, chairs side techniques and consideration. With this he presented a case report of class IV restoration, using Nano filled composites using single shade. He concluded that single shade technique is simplified when compared with the use of multiple shades and layering, which reduces chair side time without compromising results.

Margeas (2010) [32] reviewed on the developments in composite resins available. He described various factors necessary in optimizing composite esthetics, which included shade selection, opacity and translucency and various techniques like single shade, dual shade and multilayering technique. With the above considerations, he presented 2 case reports of composite restoration, one using multilayering technique and another using single shade technique. He concluded that each type of composite offers different physical and esthetic characteristics that must be considered when selecting a composite and technique for individual cases.

Yamanel et al (2010) [52] evaluated the color parameters of resin composite shade guides determined using colorimeter and digital imaging method. Four composite shade guides viz; two nanohybrid (Grandio and Permise) and two hybrid (Charisma and Filtek Z250) were evaluated. 10 shade tabs were selected (A1, A2, A3, A4, A3.5, B1, B2, B3, C3, C2) from each shade guide and CIE L*a*b values were obtained using digital imaging and colorimeter. With both measurement methods in total, 80% of shade guide pairs from different composites showed color difference greater than 3.7 and 49% had obvious matches. The authors suggested that the best shade match was recorded for A1, A2, A3 shade pairs and interchanging use of shade guide from different components systems should be avoided.

Barutcigil et al (2011) [4] conducted a study to evaluate esthetic restorative material's color differences after setting and color matching between set materials and shade guide. The authors evaluated 13 resin brand composites, 2 poly acid modified resin composites and a conventional GIC. The authors concluded that most of the materials exhibited a significant color change after polymerization and did not match the shade guide tab after undergoing light curing.

Blank (2011) [8] described the current trends in cosmetic dentistry with advancements in composite resin technology. He focused on a logical approach to composite layering, which mimicked and corresponds to histological structures of tooth. He described this technique as histological layering technique. He presented 2 case reports in which he used histological layering technique in restoration of class III and class IV defects. The author found that histological layering technique can be used for preparation of all classes and sizes and will be suitable for more contemporary systems.

Ostervemb et al (2011) [36] conducted a study to compare the esthetic properties of different composite materials and evaluated the ability of four different composite systems to imitate the natural shade of teeth in a new approach. Extracted teeth were restored with four different composite materials according to manufacturer's instruction. The time for placement and shades used were recorded. Esthetic match of the restoration was recorded using slightly modified

Extended Visual Rating Scale. The authors concluded that restoration were esthetically acceptable up to 91% to 96% of the cases. More time was needed using more advanced systems.

Tung et al (2011) [47] conducted a study to find the effect of different illuminants and cameras white balance setups on the color rendering of digital images and effectiveness of color matching using digital images. Fifteen ceramic disks of different shades were fabricated and photographed with a digital camera in both automatic white balance (AWB) and custom white balance (CWB) under LED electronic ring flash. CIE L*a*b value of captured images were derived from shade guides. The authors found that reliability of color matching with digital images is much influenced by illuminants and cameras white balance set ups, while digital shade guides derived under LED illuminants with CWB demonstrates applicable potential in the field of color assessments.

Tam and Lee (2012) [43] proposed a new method to compare the color of shade tabs taken by a digital camera using appropriate color feature. Image of shade tabs of Vita 3D Master shade guide was taken using Canon EOS 1100D digital camera. The color of the tooth surface was presented by a content manually cropped out of the image. The content was divided into 10 x 2 blocks to encode the color distribution. Color spaces were evaluated. The top *n* matches were selected when the least *n* shade distance between the shade tabs were attained. Sa*b* feature was used for shade matching using digital cameras. This method was found to overcome some drawbacks from devices such as colorimeter or spectrophotometer.

Materials and methods

Armamentarium

Materials used:

1. Acrylic resin (DPI-RR cold cure, Wallace st, Mumbai, India)
2. Ceram –X –Mono M2 shade (B.no-1008002954, Dentsply, Germany)
3. Ceram –X –Duo D2 shade (B.no-1004000026, Dentsply, Germany)
4. Ceram –X-Duo E1 shade (B.no-1004000027, Dentsply, Germany)
5. Distilled water (MANICKS, India)
6. Filtek Z250-B2 shade Universal Restorative (B.no-N173644, 3M ESPE, U.S.A)
7. Filtek Z350 XT- B3 body shade Universal Restorative (B.no-N342420, 3M ESPE, U.S.A)
8. Filtek Z350 XT –B2 enamel shade Universal Restorative (B.no-N194705, 3M ESPE, U.S.A)
9. SYNERGY NANO FORMULA–B2/A2 shade (B.no-0166934, Coltene/Whaledent, Altsatten/Switzerland)
10. SYNERGY D6 universal duo-shade Nano composite: DENTINE-A2/B2 shade (B.no-B04741, Coltene/Whaledent,Altsatten/Switzerland)
11. SYNERGY D6 universal duo-shade Nano composite-ENAMEL UNIVERSAL (B.no-02080231, Coltene/Whaledent,Altsatten/Switzerland).
12. Putty impression material (Vinyl polysiloxane 3M ESPE Express STD, B.no-N395836, 3M ESPE, U.S.A).

13. 37% phosphoric acid. (Scotchbond multipurpose etchant, B.no--N354703, 3M ESPE, U.S.A)
14. 5th generation bonding agent. (Adaper Single Bond 2, B.no-- N317523, 3M ESPE, U.S.A)

Instruments and Devices used:

1. Composite instruments (Titanium coated GOLD #G2, GDC, India)
2. Contra angled airotor handpiece (W&H High Speed Hand Piece Press type, Model TC-95RM, Austria)
3. Digital SLR camera (Nikon, D-3000, 10.2 megapixel, Japan)
4. Flat end taper diamond abrasive (TF 11,Dia-Burs, Mani Inc, Japan)
5. Light cure unit (bluephase C8 (G2), ivoclar vivadent, Austria)
6. Micro motor (NSK, Contra Angled Hand Piece latch type, Japan)
7. Super –Snap, Rainbow Technique Kit (SHOFU INC, KYOTO, Japan).
8. UV light (Philips FD TL 4W BLB Black Light UV lamp, Netherlands)
9. Vitapan classical shade guide (fur die VITAPAN Farben A1-D4, VITA, Germany)
10. White light (Philips focusline –dental lamp-14V 35W,Netherlands)
11. Yellow light (Philips focusline –dental lamp-12V 15W,Netherlands)

Figure - 1:Materials used

Figure - 2:Instruments and devices used

Collection of tooth:

50 Maxillary incisors extracted due to avulsion, root fractures or periodontal reasons were used for this study and teeth with the presence of caries, restorations, craze lines on the coronal aspect and also tooth with attrition, erosion, abrasion and intrinsic stains were excluded. For the selected teeth scaling was done using ultrasonic tips and stored in solution saturated with 0.1% thymol at room temperature for 1 week.

Selection of tooth:

After one week the teeth were cleaned and stored in distilled water at 4^{o} C for a week. 36 teeth having B2 shade were selected using vita classical shade guide by 3 operators to avoid errors (Figure-6). Teeth were then subsequently embedded in acrylic resin (DPI-RR cold cure, Wallace st, Mumbai, India) such that the root is covered with resin and crown structure is visible. Putty index (Vinyl polysiloxane impression material putty - 3M ESPE Express STD, N395836, 3M ESPE, U.S.A) was made for each tooth to obtain the template of the crown (Figure-7)

Class IV cavity preparation:

A class IV defect was stimulated by removing enamel and dentin from the mesial edge of each tooth using contra angled airotor handpiece (W&H High Speed Hand Piece Press type, Model TC-95RM, Austria) and flat end taper diamond abrasive (TF 11,Dia-Burs, Mani Inc, Japan). A flat –fractured surface was obtained by removing two-third of the mesial side of the clinical crown from the incisal edge. A bevel of 1.0mm to 1.5mm was prepared on the facial enamel (Figure -8) followed by etching and bonding using 37% phosphoric acid (Scotchbond multipurpose etchant, B-N354703, 3M ESPE, U.S.A) and 5^{th} generation bonding agent (Adaper Single Bond 2,B- N317523, 3M ESPE, U.S.A) respectively.

Classification of groups:

36 teeth were then randomly divided into 3 groups according to different manufacturers (3M ESPE, Coltene /Whaledent and Dentsply), consisting of 12 teeth in each group. 12 teeth is further divided into 2 subgroups based on techniques used for composite build up namely mono layering (single shade build up) and natural layering (dual shade build up) of the same manufacturer. Shade of each composite material was selected according to manufacturer instructions (natural layering technique). Each manufacturer has separate shade guide corresponding to VITA shade guide. (Figure -3, 4 and 5)

Group 1: Mono Shade; B2 Shade = Ceram –X –Mono M2, (B-1008002954, Dentsply, Germany)

Group 2: Dual Shade; B2 Shade = Ceram –X –Duo D2 +E1 (D2 [B-1004000026] and E1 [B-1004000027] Dentsply, Germany)

Group 3: Mono Shade; B2 Shade = SYNERGY NANO FORMULA (B2/A2), (B- 0166934, Coltene/Whaledent, Altsatten/Switzerland)

Group 4: Dual Shade; B2 Shade = SYNERGY D6 universal duo-shade Nano Composite- DENTINE-A2/B2 + ENAMEL –UNIVERSAL (B-O4741, B-02080231, Coltene/Whaledent, Altsatten/Switzerland).

Group 5: Mono Shade; B2 Shade = Filtek Z250-B2, (B- N173644, 3M ESPE, U.S.A)

Group 6: Dual Shade; B2 Shade = Filtek Z350 XT- B3 body shade + B2 enamel (B-N342420, B-N194705, 3M ESPE, U.S.A).

Figure - 3: Dentsply shade tab

Figure - 4: Coltene/Whaledent shade tab

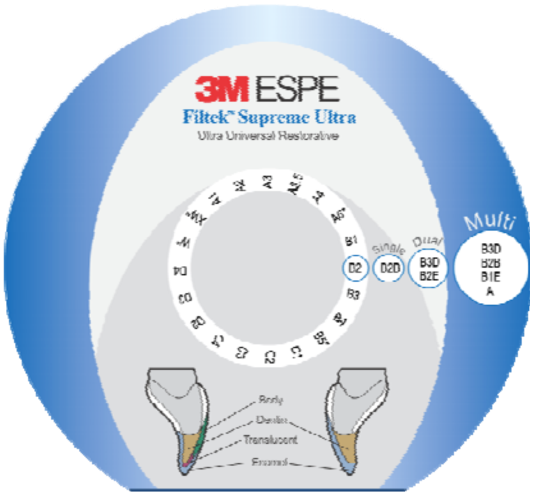


Figure -5: 3M ESPE shade wheel

Procedures of composite build up:

18 Teeth were restored according to Natural layering technique. Using composite instruments (Titanium coated GOLD #G2, GDC) a thin layer (about 0.5 to 1.0mm) of enamel shade was placed into the silicon guide. This initial palatal increment was polymerized and the silicone index removed (Figure – 9), followed by the application and shaping of the dentin increment (to simulate the original dentin shape). Polymerization of the dentin layer was followed by the closing with the facial enamel increment [about 0.5mmto 1.0mm](Figure-10). The remaining 18 teeth were restored with single shade in oblique increments with the help of silicon index. Finishing and polishing was done with abrasive disk (Super – Snap, Rainbow Technique Kit,SHOFU INC,KYOTO,Japan).

All specimens were then stored in distilled water at room temperature for 2 weeks to allow enamel/dentin rehydration. Following rehydration, each tooth was photographed under different standardized light.

Photographic procedure:

Four different light sources were used and they are as follows:

Sun light - photographs was taken in day time between 10am to 12 pm

White light – (Philips focusline –dental lamp-14V 35W, Netherlands)

Yellow light – (Philips focusline –dental lamp-12V 15W, Netherlands)

UV light - (Philips FD TL 4W BLB Black Light UV lamp, Netherlands)

Teeth were placed against a black background with the light source kept at 13-inch distance from the tooth on the either side and placed at 45 degree angle to the camera.

Digital Nikon SLR camera (Nikon, D-3000, 10.2 megapixel, Japan), with 105nm macro photography lens (Micro Nikkor AF 105nmm with Close Up No.4T, Nikon) at 1.5X magnification was used to take the photographs which was kept at 15-inch distance from the tooth [2]. Four photographs were taken under four light sources (Figure -11).

All the photographs were arranged as illustrated in (Figure - 13, 14, 15, 16, 17, 18). All the photographs were presented to the evaluators without the brand name where only number codes were used. Five evaluators participated in the study and Modified EVRSAM score [36] was used to evaluate the esthetic match of the restorations in the given photographs (Figure -12)

Statistical analysis:

SPSS software version 17.0 was used as an analytical tool. The mean score were analyzed with Oneway analysis of variance (ANOVA) to compare different groups under individual lights and Student *t* - test was done to compare between groups under different lights. p values was set less than 0.05 ($p<0.05$).

Figure 6

Shade selection B2 shade tab

Figure 7

Tooth mounted on acrylic block

Putty index fabrication

Figure 8

Class IV cavity preparation with bevel on facial surface.

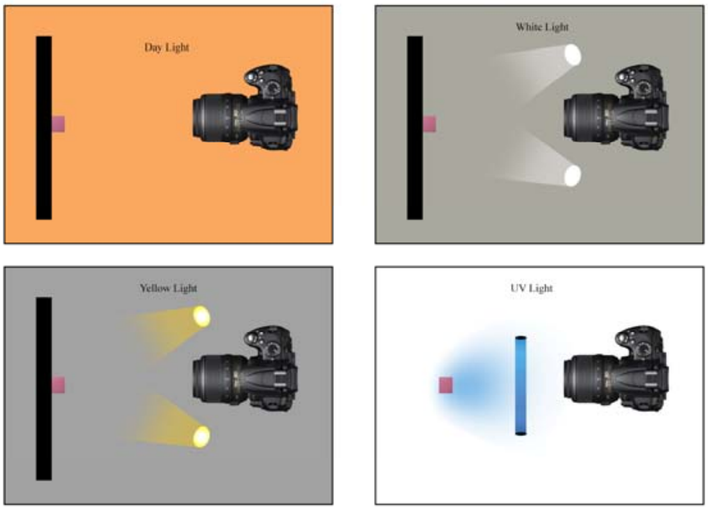
Figure 9

Enamel composite placement on palatal aspect.

Figure 10

Dentine composite placed over enamel composite.

Figure - 11 - Schematic Representation of Photographic Setup



MODIFIED EVRSAM	
Rating	Description
0	The restoration can only be delineated with difficulty
2	Very slight mismatch
4	Obvious mismatch but within in a acceptable range for almost all patients
6	Poor esthetics on the border line of acceptability
8	Very poor esthetics; unacceptable for nearly all patients
10	Totally unacceptable esthetics
Note: Intermediate rating of 1, 3, 5, 7 and 9 may be given if the description of esthetic match falls intermediate to any two adjacent descriptions given above.	

Figure 12 – Modified EVRSAM score chart

Figure - 13

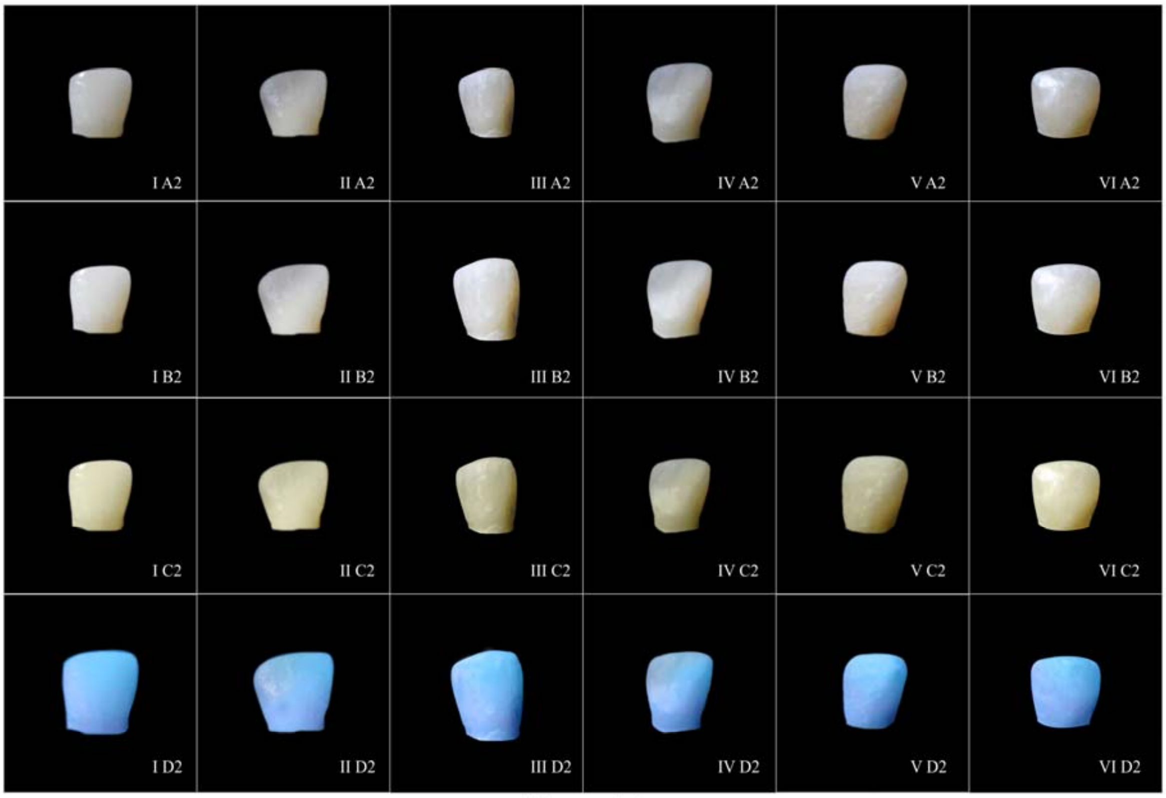


Figure - 14

Figure - 15

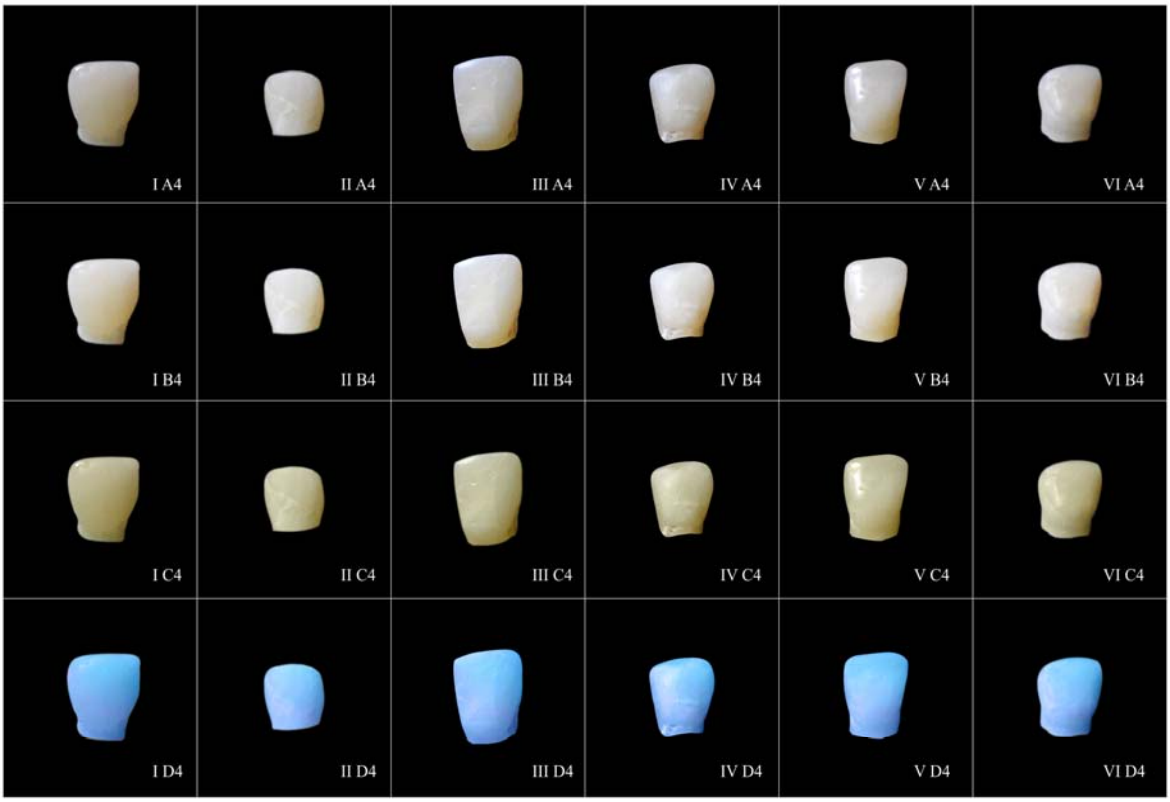


Figure - 16

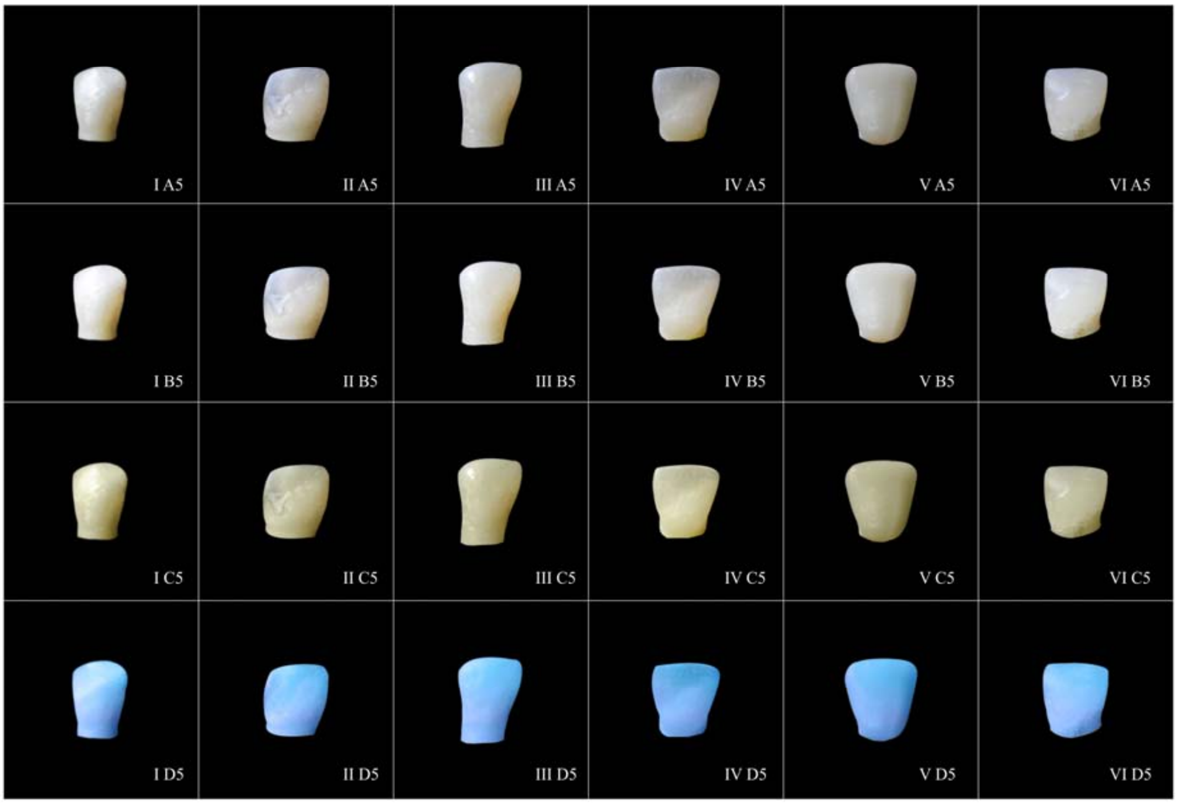


Figure - 17

Figure - 19

Results

TABLE: 1- One way ANOVA for the mean difference in Modified EVRSAM scores among different groups under sunlight.

GROUPS	N	Mean	Standard Deviation	Standard Error
Group 1	**6**	**2.4333**	**2.25004**	**0.91857**
Group 2	**6**	**5.0333**	**1.66573**	**0.68003**
Group 3	**6**	**3.0667**	**1.29409**	**0.52831**
Group 4	**6**	**4.8667**	**1.24365**	**0.50772**
Group 5	**6**	**2.4667**	**1.19168**	**0.48626**
Group 6	**6**	**2.3000**	**0.83666**	**0.34157**
Total	**36**	**3.3611**	**1.80084**	**0.30014**

TABLE: 2

Sunlight

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	47.619	5	9.524	4.336	.004
Within Groups	65.887	30	2.196		
Total	113.506	35			

In the above table the F value 4.336 for the mean difference among the group under sunlight shows a significant difference ($p<0.004$). It reveals there is an esthetic difference among the different groups under sunlight.

TABLE: 3 - <u>One way ANOVA</u> <u>for the mean difference in Modified EVRSAM scores among different groups under white light.</u>

GROUPS	N	Mean	Standard Deviation	Standard Error
Group 1	**6**	**2.5333**	**2.25802**	**0.92183**
Group 2	**6**	**4.7667**	**1.94902**	**0.79568**
Group 3	**6**	**2.8000**	**1.21326**	**0.49531**
Group 4	**6**	**4.1000**	**1.37840**	**0.56273**
Group 5	**6**	**1.8667**	**1.18434**	**0.48351**
Group 6	**6**	**1.9000**	**0.60332**	**0.24631**
Total	**36**	**2.9944**	**1.79427**	**0.29904**

TABLE :4

White Light

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	42.499	5	8.500	3.633	.011
Within Groups	70.180	30	2.339		
Total	112.679	35			

In the above table the F value 3.633 for the mean difference among the groups under white light shows a significant difference ($p<0.011$). It reveals there is an esthetic difference among the different groups under white light.

TABLE: 5 - <u>One way ANOVA</u> <u>for the mean difference in Modified EVRSAM scores among different groups under yellow light</u>

GROUPS	N	Mean	Standard Deviation	Standard Error
Group 1	**6**	**2.5000**	**1.8465**	**0.75144**
Group 2	**6**	**4.8667**	**1.83594**	**0.74952**
Group 3	**6**	**3.3667**	**1.58703**	**0.64790**
Group 4	**6**	**4.4333**	**0.8711**	**0.35559**
Group 5	**6**	**2.2333**	**1.01522**	**0.41446**
Group 6	**6**	**2.2333**	**0.55737**	**0.22755**
Total	**36**	**3.2722**	**1.66315**	**0.27719**

TABLE :6

Yellow Light

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	39.926	5	7.985	4.211	.005
Within Groups	56.887	30	1.896		
Total	96.812	35			

In the above table the F value 4.211 for the mean difference among the groups under yellow light shows a significant difference ($p<0.005$). It reveals there is an esthetic difference among the different groups under yellow light.

TABLE: 7 - One way ANOVA for the mean difference in Modified EVRSAM scores among different groups under UV light.

GROUPS	**N**	**Mean**	**Standard Deviation**	**Standard Error**
Group 1	**6**	**2.5000**	**1.99499**	**0.81445**
Group 2	**6**	**4.6000**	**1.35056**	**0.55136**
Group 3	**6**	**2.9667**	**1.55649**	**0.63544**
Group 4	**6**	**4.2333**	**0.77374**	**0.31588**
Group 5	**6**	**2.1333**	**1.17075**	**0.47796**
Group 6	**6**	**2.1333**	**0.72296**	**0.29515**
Total	**36**	**3.0944**	**1.58816**	**0.26469**

TABLE: 8

UV Light

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	34.686	5	6.937	3.883	.008
Within Groups	53.593	30	1.786		
Total	88.279	35			

In the above table the F value 3.883 for the mean difference among the groups under UV light shows a significant difference ($p<0.008$). It reveals there is an esthetic difference among the different groups under UV light.

TABLE: 9 – Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 1**	**6**	**2.4333**	**2.25004**	**2.275**	**0.046**
	Group 2	**6**	**5.0333**	**1.66573**		
White light	**Group 1**	**6**	**2.5333**	**2.25802**	**1.834**	**0.097**
	Group 2	**6**	**4.7667**	**1.94902**		
Yellow light	**Group 1**	**6**	**2.5000**	**1.84065**	**2.230**	**0.050**
	Group 2	**6**	**4.8667**	**1.83594**		
UV light	**Group 1**	**6**	**2.5000**	**1.99499**	**2.135**	**0.059**
	Group 2	**6**	**4.6000**	**1.35056**		

In the above table the t value (2.275) for the mean difference in Modified EVRSAM score between group 1 and group 2 at sunlight is significant ($p<0.046$). The mean Modified EVRSAM score of group 1 and group 2 were 2.433 and 4.866 respectively. It can be inferred that group 1 has more esthetic match when compared with group 2 under sunlight.

The t value (1.834) mean difference in Modified EVRSAM score between group 1 and group 2 under white lights is not significant ($p=0.097$).

The t value (2.230) mean difference in Modified EVRSAM score between group 1 and group 2 under yellow light is significant ($p<0.050$). The mean Modified EVRSAM score of group 1 and group 2 were 2.500 and 4.8667 respectively. It can be inferred that group 1 has more esthetic match when compared with group 2 under yellow light.

The t value (2.135) mean difference in Modified EVRSAM score between group 1 and group 2 under UV lights is significant ($p<0.059$). The mean Modified EVRSAM score of group 1 and group 2 were 2.5000 and 4.600 respectively. It can be inferred that group 1 has more esthetic match when compared with group 2 under UV light.

TABLE: 10 – Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 1**	**6**	**2.4333**	**2.25004**	**0.598**	**0.563**
	Group 3	**6**	**3.0667**	**1.29409**		
White light	**Group 1**	**6**	**2.5333**	**2.25802**	**0.255**	**0.804**
	Group 3	**6**	**2.8000**	**1.21326**		
Yellow light	**Group 1**	**6**	**2.5000**	**1.84065**	**0.873**	**0.403**
	Group 3	**6**	**3.3667**	**1.58703**		
UV light	**Group 1**	**6**	**2.5000**	**1.99499**	**0.452**	**0.661**
	Group 3	**6**	**2.9667**	**1.55649**		

In the above table the t value (0.598) for the mean difference in Modified EVRSAM score between group 1 and group 3 under sunlight not significant (p=0.563).

The t value (0.255) mean difference in Modified EVRSAM score between group 1 and group 3 under white lights is not significant (p=0.804).

The t value (0.873) mean difference in Modified EVRSAM score between group 1 and group 3 under yellow light is not significant (p=0.403).

The t value (0.452) mean difference in Modified EVRSAM score between group 1 and group 3 under UV lights is not significant (p=0.661).

TABLE: 11– Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 1**	**6**	**2.4333**	**2.25004**	**2.318**	**0.043**
	Group 4	**6**	**4.8667**	**1.24365**		
White light	**Group 1**	**6**	**2.5333**	**2.25802**	**1.451**	**0.178**
	Group 4	**6**	**4.1000**	**1.37840**		
Yellow light	**Group 1**	**6**	**2.5000**	**1.84065**	**2.326**	**0.042**
	Group 4	**6**	**4.4333**	**0.87101**		
UV light	**Group 1**	**6**	**2.5000**	**1.99499**	**1.984**	**0.075**
	Group 4	**6**	**4.2333**	**0.77374**		

In the above table the t value (2.318) for the mean difference in Modified EVRSAM score between group 1 and group 4 under sunlight is significant (p<0.043). The mean Modified EVRSAM score of group 1 and group 4 were 2.433 and 4.866 respectively. It can be inferred that group 1 has more esthetic match when compared with group 4 under sunlight.

The t value (1.451) mean difference in Modified EVRSAM score between group 1 and group 4 under white lights is not significant ($p=0.178$).

The t value (2.326) mean difference in Modified EVRSAM score between group 1 and group 4 under yellow light is significant ($p<0.042$). The mean Modified EVRSAM score of group 1 and group 4 were 2.500 and 4.433 respectively. It can be inferred that group 1 has more esthetic match when compared with group 4 under yellow light.

The t value (1.984) mean difference in Modified EVRSAM score between group 1 and group 4 under UV lights is not significant ($p=0.075$).

TABLE: 12 – Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 1**	**6**	**2.4333**	**2.25004**	**0.032**	**0.975**
	Group 5	**6**	**2.4667**	**1.19108**		
White light	**Group 1**	**6**	**2.5333**	**2.25802**	**0.640**	**0.536**
	Group 5	**6**	**1.8667**	**1.18434**		
Yellow light	**Group 1**	**6**	**2.5000**	**1.84065**	**0.311**	**0.762**
	Group 5	**6**	**2.2333**	**1.01522**		
UV light	**Group 1**	**6**	**2.5000**	**1.99499**	**0.388**	**0.706**
	Group 5	**6**	**2.1333**	**1.17075**		

In the above table the t value (0.032) for the mean difference in Modified EVRSAM score between group 1 and group 5 under sunlight is not significant (p=0.975).

The t value (0.640) mean difference in Modified EVRSAM score between group 1 and group 5 under white lights is not significant (p=0.536).

The t value (0.311) mean difference in Modified EVRSAM score between group 1 and group 5 under yellow lights is not significant (p=0.762).

The t value (0.388) mean difference in Modified EVRSAM score between group 1 and group 5 under UV lights is not significant (p=0.706).

TABLE: 13 – Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 1**	**6**	**2.4333**	**2.25004**	**0.136**	**0.894**
	Group 6	**6**	**2.3000**	**0.83666**		
White light	**Group 1**	**6**	**2.5333**	**2.25802**	**0.664**	**0.522**
	Group 6	**6**	**1.9000**	**0.60332**		
Yellow light	**Group 1**	**6**	**2.5000**	**1.84065**	**0.340**	**0.741**
	Group 6	**6**	**2.2333**	**0.55737**		
UV light	**Group 1**	**6**	**2.5000**	**1.99499**	**0.423**	**0.681**
	Group 6	**6**	**2.1333**	**0.72296**		

In the above table the t value (0.136) for the mean difference in Modified EVRSAM score between group 1 and group 6 under sunlight not significant (p=0.894).

The t value (0.664) mean difference in Modified EVRSAM score between group 1 and group 6 under white lights is not significant ($p=0.522$).

The t value (0.340) mean difference in Modified EVRSAM score between group 1 and group 6 under yellow light is not significant ($p=0.741$).

The t value (0.423) mean difference in Modified EVRSAM score between group 1 and group 6 under UV lights is not significant ($p=0.681$).

TABLE: 14 – Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 2**	**6**	**5.0333**	**1.66573**	**2.284**	**0.045**
	Group 3	**6**	**3.0667**	**1.29409**		
White light	**Group 2**	**6**	**4.7667**	**1.94902**	**2.098**	**0.062**
	Group 3	**6**	**2.8000**	**1.21326**		
Yellow light	**Group 2**	**6**	**4.8667**	**1.83594**	**1.514**	**0.161**
	Group 3	**6**	**3.3667**	**1.58703**		
UV light	**Group 2**	**6**	**4.6000**	**1.35056**	**1.941**	**0.081**
	Group 3	**6**	**2.9667**	**1.55649**		

In the above table the t value (2.284) for the mean difference in Modified EVRSAM score between group 2 and group 3 under sunlight is significant ($p<0.045$). The mean Modified EVRSAM score of group 2 and group 3 were 5.033 and 3.0667 respectively. It can be inferred that group 3 has more esthetic match when compared with group 2 under sunlight.

The t value (2.098) mean difference in Modified EVRSAM score between group 2 and group 3 under white lights is not significant ($p=0.062$).

The t value (1.514) mean difference in Modified EVRSAM score between group 2 and group 3 under yellow light is not significant ($p=0.161$).

The t value (1.941) mean difference in Modified EVRSAM score between group 2 and group 3 under UV lights is not significant (p=0.081).

TABLE: 15 – Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 2**	**6**	**5.0333**	**1.66573**	**0.196**	**0.848**
	Group 4	**6**	**4.8667**	**1.24365**		
White light	**Group 2**	**6**	**4.7667**	**1.94902**	**0.684**	**0.509**
	Group 4	**6**	**4.1000**	**1.37840**		
Yellow light	**Group 2**	**6**	**4.8667**	**1.83594**	**0.522**	**0.613**
	Group 4	**6**	**4.4333**	**0.87101**		
UV light	**Group 2**	**6**	**4.6000**	**1.35056**	**0.577**	**0.577**
	Group 4	**6**	**4.2333**	**0.77374**		

In the above table the t value (0.196) for the mean difference in Modified EVRSAM score between group 2 and group 4 under sunlight not significant (p=0.848).

The t value (0.684) mean difference in Modified EVRSAM score between group 2 and group 4 under white lights is not significant (p=0.509).

The t value (0.522) mean difference in Modified EVRSAM score between group 2 and group 4 under yellow light is not significant (p=0.613).

The t value (0.577) mean difference in Modified EVRSAM score between group 1 and group 6 under UV lights is not significant (p=0.577).

TABLE: 16 – Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 2**	**6**	**5.0333**	**1.66573**	**3.070**	**0.012**
	Group 5	**6**	**2.4667**	**1.19168**		
White light	**Group 2**	**6**	**4.7667**	**1.94902**	**3.115**	**0.011**
	Group 5	**6**	**1.8667**	**1.18434**		
Yellow light	**Group 2**	**6**	**4.8667**	**1.83594**	**3.075**	**0.012**
	Group 5	**6**	**2.2333**	**1.01522**		
UV light	**Group 2**	**6**	**4.6000**	**1.35056**	**3.380**	**0.007**
	Group 5	**6**	**2.1333**	**1.17075**		

In the above table the t value (3.070) for the mean difference in Modified EVRSAM score between group 2 and group 5 under sunlight is significant (p<0.012). The mean Modified

EVRSAM score of group 2 and group 5 were 5.033 and 2.4667 respectively. It can be inferred that group 5 has more esthetic match when compared with group 2 under sunlight.

The t value (3.115) mean difference in Modified EVRSAM score between group 2 and group 5 under white lights is significant ($p<0.011$). The mean Modified EVRSAM score of group 2 and group 5 were 4.7667 and 1.8667 respectively. It can be inferred that group 5 has more esthetic match when compared with group 2 under white light.

The t value (3.075) mean difference in Modified EVRSAM score between group 2 and group 5 under yellow lights is significant ($p<0.012$). The mean Modified EVRSAM score of group 2 and group 5 were 4.8667 and 2.2333 respectively. It can be inferred that group 5 has more esthetic match when compared with group 2 under yellow light.

The t value (3.380) mean difference in Modified EVRSAM score between group 2 and group 5 under UV lights is significant ($p<0.007$). The mean Modified EVRSAM score of group 2 and group 5 were 4.6000 and 2.1333 respectively. It can be inferred that group 5 has more esthetic match when compared with group 2 under UV light.

TABLE: 17 – Mean difference in **Modified EVRSAM** score between different groups under various light sources**.**

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 2**	**6**	**5.0333**	**1.66573**	**3.592**	**0.005**
	Group 6	**6**	**2.3000**	**0.83666**		
White light	**Group 2**	**6**	**4.7667**	**1.94902**	**3.442**	**0.006**
	Group 6	**6**	**1.9000**	**0.60332**		
Yellow light	**Group 2**	**6**	**4.8667**	**1.83594**	**3.362**	**0.007**
	Group 6	**6**	**2.2333**	**0.55737**		
UV light	**Group 2**	**6**	**4.6000**	**1.35056**	**3.944**	**0.007**
	Group 6	**6**	**2.1333**	**0.72296**		

In the above table the t value (3.592) for the mean difference in Modified EVRSAM score between group 2 and group 6 under sunlight is significant ($p<0.005$). The mean Modified EVRSAM score of group 2 and group 6 were 5.033 and 2.3000 respectively. It can be inferred that group 6 has more esthetic match when compared with group 2 under sunlight.

The t value (3.442) mean difference in Modified EVRSAM score between group 2 and group 6 under white lights is significant ($p<0.006$). The mean Modified EVRSAM score of group 2 and group 6 were 4.7667 and 1.9000 respectively. It can be inferred that group 6 has more esthetic match when compared with group 2 under white light.

The t value (3.362) mean difference in Modified EVRSAM score between group 2 and group 6 under yellow lights is significant ($p<0.007$). The mean Modified EVRSAM score of group 2 and group 6 were 4.8667 and 2.2333 respectively. It can be inferred that group 6 has more esthetic match when compared with group 2 under yellow light.

The t value (3.944) mean difference in Modified EVRSAM score between group 2 and group 6 under UV lights is significant ($p<0.003$). The mean Modified EVRSAM score of group 2 and group 6 were 4.6000 and 2.1333 respectively. It can be inferred that group 6 has more esthetic match when compared with group 2 under UV light.

TABLE: 18 – Mean difference in **Modified EVRSAM** score between different groups under various light sources

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 3**	**6**	**3.0667**	**1.29409**	**2.457**	**0.034**
	Group 4	**6**	**4.8667**	**1.24365**		
White light	**Group 3**	**6**	**2.8000**	**1.21326**	**1.734**	**0.114**
	Group 4	**6**	**4.1000**	**1.37840**		
Yellow light	**Group 3**	**6**	**3.3667**	**1.58703**	**1.443**	**0.180**
	Group 4	**6**	**4.4333**	**0.87101**		
UV light	**Group 3**	**6**	**2.9667**	**1.55649**	**1.785**	**0.105**
	Group 4	**6**	**4.2333**	**0.77374**		

In the above table the t value (2.457) for the mean difference in Modified EVRSAM score between group 3 and group 4 under sunlight is significant ($p<0.034$). The mean Modified EVRSAM score of group 3 and group 4 were 3.0667 and 4.8667 respectively. It can be inferred that group 3 has more esthetic match when compared with group 4 under sunlight.

The t value (1.734) mean difference in Modified EVRSAM score between group 3 and group 4 under white lights is not significant ($p=0.114$).

The t value (1.443) mean difference in Modified EVRSAM score between group 3 and group 4 under yellow lights is not significant (p=0.180).

The t value (1.785) mean difference in Modified EVRSAM score between group 3 and group 4 under UV lights is not significant (p=0.105).

TABLE: 19 – Mean difference in **Modified EVRSAM** score between different groups under various light sources

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 3**	**6**	**3.0667**	**1.29409**	**0.836**	**0.423**
	Group 5	**6**	**2.4667**	**1.19168**		
White light	**Group 3**	**6**	**2.8000**	**1.21326**	**1.348**	**0.207**
	Group 5	**6**	**1.8667**	**1.18434**		
Yellow light	**Group 3**	**6**	**3.3667**	**1.58703**	**1.474**	**0.171**
	Group 5	**6**	**2.2333**	**1.01522**		
UV light	**Group 3**	**6**	**2.9667**	**1.55649**	**1.048**	**0.319**
	Group 5	**6**	**2.1333**	**1.17075**		

In the above table the t value (0.836) for the mean difference in Modified EVRSAM score between group 3 and group 5 under sunlight is not significant (p=0.423).

The t value (1.348) mean difference in Modified EVRSAM score between group 3 and group 5 under white lights is not significant (p=0.207).

The t value (1.474) mean difference in Modified EVRSAM score between group 3 and group 5 under yellow lights is not significant (p=0.171).

The t value (1.048) mean difference in Modified EVRSAM score between group 3 and group 5 under UV lights is not significant (p=0.319).

TABLE: 20 – Mean difference in **Modified EVRSAM** score between different groups under various light sources

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 3**	**6**	**3.0667**	**1.29409**	**1.219**	**0.251**
	Group 6	**6**	**2.3000**	**0.83666**		
White light	**Group 3**	**6**	**2.8000**	**1.21326**	**1.627**	**0.135**
	Group 6	**6**	**1.9000**	**0.60332**		
Yellow light	**Group 3**	**6**	**3.3667**	**1.58703**	**1.650**	**0.130**
	Group 6	**6**	**2.2333**	**0.55737**		
UV light	**Group 3**	**6**	**2.9667**	**1.55649**	**1.189**	**0.262**
	Group 6	**6**	**2.1333**	**0.72296**		

In the above table the t value (1.219) for the mean difference in Modified EVRSAM score between group 3 and group 6 under sunlight is not significant (p=0.251).

The t value (1.627) mean difference in Modified EVRSAM score between group 3 and group 6 under white lights is not significant (p=0.135).

The t value (1.650) mean difference in Modified EVRSAM score between group 3 and group 6 under yellow lights is not significant (p=0.130).

The t value (1.189) mean difference in Modified EVRSAM score between group 3 and group 6 under UV lights is not significant (p=0.262).

TABLE: 21 – Mean difference in **Modified EVRSAM** score between different groups under various light sources.

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 4**	**6**	**4.8667**	**1.24365**	**3.414**	**0.007**
	Group 5	**6**	**2.4667**	**1.19168**		
White light	**Group 4**	**6**	**4.1000**	**1.37840**	**3.010**	**0.013**
	Group 5	**6**	**1.8667**	**1.18434**		
Yellow light	**Group 4**	**6**	**4.4333**	**0.87101**	**4.029**	**0.002**
	Group 5	**6**	**2.2333**	**1.01522**		
UV light	**Group 4**	**6**	**4.2333**	**0.77374**	**3.666**	**0.004**
	Group 5	**6**	**2.1333**	**1.17075**		

In the above table t value (4.8669) mean difference in Modified EVRSAM score between group 4 and group 5 under sunlight is significant (p<0.007). The mean Modified EVRSAM score of group 4 and group 5 were 4.8667 and 2.4667 respectively .It can be inferred that group 5 has more esthetic match when compared with group 4 under sunlight.

The t value (3.010) mean difference in Modified EVRSAM score between group 4 and group 5 under white lights is significant ($p<0.013$). The mean Modified EVRSAM score of group 4 and group 5 were 4.1000 and 1.8667 respectively. It can be inferred that group 5 has more esthetic match when compared with group 4 under white light.

The t value (4.029) mean difference in Modified EVRSAM score between group 4 and group 5 under yellow lights is significant ($p<0.002$). The mean Modified EVRSAM of group 4 and group 5 were 4.4333 and 2.2333 respectively. It can be inferred that group 5 has more esthetic match when compared with group 4 under yellow light.

The t value (3.666) mean difference in Modified EVRSAM score between group 4 and group 5 under UV lights is significant ($p<0.004$). The mean Modified EVRSAM score of group 4 and group 5 were 4.2333 and 2.1333 respectively. It can be inferred that group 5 has more esthetic match when compared with group 4 under UV light.

TABLE: 22 – Mean difference in **Modified EVRSAM** score between different groups under various light sources.

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 4**	**6**	**4.8667**	**1.24365**	**4.194**	**0.002**
	Group 6	**6**	**2.3000**	**0.83666**		
White light	**Group 4**	**6**	**4.1000**	**1.37840**	**3.581**	**0.005**
	Group 6	**6**	**1.9000**	**0.60332**		
Yellow light	**Group 4**	**6**	**4.4333**	**0.87101**	**5.211**	**0.000**
	Group 6	**6**	**2.2333**	**0.55737**		
UV light	**Group 4**	**6**	**4.2333**	**0.77374**	**4.858**	**0.001**
	Group 6	**6**	**2.1333**	**0.72296**		

In the above table the t value (4.194) for the mean difference in Modified EVRSAM score between group 4 and group 6 under sunlight is significant ($p<0.002$). The mean Modified EVRSAM score of group 4 and group 6 were 4.8667 and 2.3000 respectively. It can be inferred that group 6 has more esthetic match when compared with group 4 under sunlight.

The t value (3.581) mean difference in Modified EVRSAM score between group 4 and group 6 under white lights is significant ($p<0.005$). The mean Modified EVRSAM score of group 4 and group 6 were 4.1000 and 1.9000 respectively. It can be inferred that group 6 has more esthetic match when compared with group 4 under white light.

The t value (5.211) mean difference in Modified EVRSAM score between group 4 and group 6 under yellow lights is significant ($p<0.000$). The mean Modified EVRSAM score of group 4 and group 6 were 4.4333 and 2.2333 respectively. It can be inferred that group 6 has more esthetic match when compared with group 4 under yellow light.

The t value (4.858) mean difference in Modified EVRSAM score between group 4 and group 6 under UV lights is significant ($p<0.001$). The mean Modified EVRSAM score of group 4 and group 6 were 4.2333 and 2.1333 respectively. It can be inferred that group 6 has more esthetic match when compared with group 4 under UV light.

TABLE: 23 – Mean difference in **Modified EVRSAM** score between different groups under various light sources.

		N	Mean	Standard Deviation	t value	Level of significance
Sun light	**Group 5**	**6**	**2.4667**	**1.19168**	**0.280**	**0.785**
	Group 6	**6**	**2.3000**	**0.83666**		
White light	**Group 5**	**6**	**1.8667**	**1.18434**	**0.061**	**0.952**
	Group 6	**6**	**1.9000**	**0.60332**		
Yellow light	**Group 5**	**6**	**2.2333**	**1.01522**	**0.000**	**1.000**
	Group 6	**6**	**2.2333**	**0.55737**		
UV light	**Group 5**	**6**	**2.1333**	**1.17075**	**0.000**	**1.000**
	Group 6	**6**	**2.1333**	**0.72296**		

In the above table the t value (0.280) for the mean difference in Modified EVRSAM score between group 5 and group 6 under sunlight is not significant (p=0.785).

The t value (0.061) mean difference in Modified EVRSAM score between group 5 and group 6 under white lights is not significant (p=0.952).

The t value (0.0000) mean difference in Modified EVRSAM score between group 5 and group 6 under yellow lights is not significant (p=0.100).

The t value (0.000) mean difference in Modified EVRSAM score between group 5 and group 6 under UV lights is not significant (p=1.000).

Discussion

Conservative esthetic restoration of anterior teeth using direct bonding represents a common treatment. But matching the shade especially in class IV defects provide a challenging task for the clinician [18, 40]. To make the restoration imperceptible to eyes, the underlying fracture line must be carefully disguised through the subtle combination of restorative resins of different shades and opacities[31]. Light-cured composite resins have evolved in the 1990's and have so far produced satisfactory esthetics and stronger restorations.

There are three basic types of composites; namely, Micro filled, Nano filled and Hybrid, which differ in their ability to provide esthetics. The major factor influencing esthetics is the filler content. Micro filled and Nano filled composites contain microscopic filler particles that scatter light, imparting nominal esthetics, in contrast to the conventional hybrid resins. The shape of the filler particles also influences light scattering as multifaceted particles scatter and reflect light in different directions, which may help in blending of the resin composite naturally with the tooth. Nano filled composites transmit light more than other composites [30]. In this perspective, Nano composites have been found to provide satisfactory strength, esthetics and high polish ability, including Class IV restorations in the anterior esthetic zone [33, 45, 46].

With the availability of latest composite material that has expanded the potential of esthetic restorations, many techniques have been proposed for the placement of these composites: namely Single shade technique, Dual shade technique and Multi layering technique [44]. Inspired from the realm of dental porcelain, the goal of these methods is to mimic the natural anatomy of enamel and dentin. Only 2 basic composite masses (dentin and enamel) are used to optically mimic the natural tissues [31, 20, 21, 50].

Color is often considered a major element of the esthetic success of a restoration. However, minor errors concerning that particular parameter might not be noticed if the other criteria, such as form, surface texture and opacity have been well respected. Of the 3 components of color, value is the most influential, followed by chroma and hue. Most contemporary composite resins can be used with natural layering concept but little variation in the shading systems (single hue versus multiple hues), opacities and fluorescence of these materials [31].

The ability of composite materials at a given thickness to provide opacity and translucency varies, some requiring a greater thickness than others to block out dark objects such as the oral cavity behind the teeth and a lesser thickness for translucency[27], such as would be required at incisal and proximo-incisal areas[34]. Without opalescence, the composite resin will appear dull. Opalescence matching that of natural teeth is possible with composite resins. In fact, one study found the opalescence of tested direct composite resins to be more tooth-like than that of indirect composite materials or ceramics[53].

Various studies have shown that different light sources affect the perceived color as lighting plays a very important role in shade matching and restoration outcome. The color we see depends on the nature of the light source illuminating the object. The color of an opaque object is the sum of the wavelengths that is reflected off it. Light spectrum reflectance graphs can be made measuring the percentage of reflectance of all the near UV and visible light spectrum of a material. The closer the curves of the two materials to be matched, the more successful the color matches will be. Ideally, both the dentist and the laboratory technician should have balanced full spectrum lighting conditions[22] .

To evaluate the optical integration of composite restoration with the tooth, a simple and clinically relevant method taking into account various lighting conditions such as sunlight, white light, yellow light and UV light and compared with remaining intact enamel/dentin as control.

In this study three brands of composite resins are used; namely Dentsply, Coltene Whaledent and 3M.All these brands have different shades of composite resins based on different techniques to be used. B2 shade was used a standard shade for comparison.

In DENTSPLY brand, (**group 1)** Ceram X mono composite was taken for single shade technique and (**group 2)** Ceram X duo composite for dual shade technique. In **group 1** (Ceram X mono) M2 shade corresponded to B2 shade which has a combination of two different shades namely A2, B2 (multiple hue). In **group 2** (Ceram X duo) combinations of D2 and E1 shades corresponds to B2 shade. D2 composite is also a blend of A2, B2 (multiple hues) shade and E1 has a combination of B1, B2, C2, D4 shade (multiple hue).

In Coltene Whaledent brand, (**group 3)** SYNERGY NANO FORMULA composite –B2 shade having multiple hues A2/ B2 was taken for single shade technique and (**group 4)** SYNERGY D6 universal duo-shade Nano composite for dual shade technique. In **group 4**, dentin A2/B2 (multiple hues) and universal enamel corresponds to B2 shade.

In 3M brand, (**group 5)** Filtek Z250-B2 composite was taken for single shade system and (**group 6)** Filtek Z350 XT composites was taken for dual shade technique. **Group 6** had a combination of B3 body shade and B2 enamel shade, which corresponds to B2 shade.

In the above groups, **group 1, group 2, group 3 and group 4** composite resins have combination of multiple hues in same syringe but **group 5 and group 6** had single hue.

Considering the difference in hue, this study evaluated the optical integration of these materials under different light sources. The results were subjected to statistical analysis. One way ANOVA (table: 1-8) and Student t test (table: 9-24) were the tools used which compared the difference between 2 groups individually under individual lights.

Under sunlight, **Group 1** was esthetically better than **group 2**(t-2.275) and **group 4**(t-2.318) showing statistically significant values ($p<0.05$). But **group 3**(t-0.598), **group 5**(t-0.032) and **group 6** (t-0.136) showed statistically insignificant values as the mean difference in the scores were similar. This infers that esthetically **group 1,group 3,group 5** and **group 6** were all the same. **Group 2** was almost esthetically similar with that of **group 4**(t-0.196). But **group 3**(t-2.284), **group 5**(t-3.070) and **group 6**(t-3.592) were esthetically better than **group 2** as the values were statistically highly significant ($p<0.001$). Comparatively **Group 3** was esthetically much better when compared to **group 4**(t-2.457) and the values were statistically significant ($p<0.05$). But **group 5**(t-0.836) and **group 6**(t-1.219) showed statistically insignificant values, as the mean difference values were similar. **Group 5**(t-3.414) and **group 6**(t-4.194) was more esthetically better than **group 4**. Though **group 5** and **group 6** showed statistically insignificant values, their mean score was relatively low when compared to other groups. Thus it infers that they both esthetically match each other. Considering the above values of Modified EVRSAM score, when compared under sunlight, **group 1, group 5** and **group 6** were esthetically pleasing compared to the other groups and values among them were not statistically significant.

Under white light, **group 1** showed a statistically insignificant value when compared with **group 2**(t-1.834), **group 3**(t-0.255), **group 4**(t-1.451), **group 5**(t-0.640) and **group 6** (t-0.664), which infers that all the groups have similar esthetic appearance. **Group 2** was almost esthetically similar with **group 3**(t-2.098) and **group 4**(t-0.684) as they were statistically insignificant. But

group 5(t-3.115) and **group 6**(t-3.442) were esthetically better than **group 2** as they were statistically highly significant ($p<0.001$). **Group 3** showed statistically insignificant values with **group 4**(t-1.734), **group 5**(t-1.348) and **group 6**(t-1.627). But **group 5** and **group 6** had a low mean difference score when compared with **group 4**. **Group 5**(t-3.010) and **group 6**(t- 3.581) were more esthetically better than **group 4** and they were highly significant ($p<0.001$). Though **group 5** and **group 6** showed statistically insignificant values, their mean score was relatively low when compared to other groups, which shows that they both have equivalent match to each other. Comparing the above results, the esthetical match of **group 1**, **group 5** and **group 6** were much better than other groups under white light.

Under yellow light, **group 1** was esthetically better than **group 2**(t-2.230) and **group 4**(t-2.326) and they were statistically significant ($p<0.05$). But **group 3**(t-0.873), **group 5**(t-0.311) and **group 6** (t-0.340) showed statistically insignificant values as the mean difference in the score were similar. This infers that esthetically **group 1**,**group 3**,**group 5** and **group 6** were the same. **Group 2** was almost esthetically similar with **group 4**(t-0.522). But **group 3**(t-1.514), **group 5**(t-3.075) and **group 6**(t-3.362) were esthetically better than **group 2** and they were statistically highly significant ($p<0.001$). **Group 3** showed statistically insignificant values with **group 4**(t-1.443), **group 5**(t-1.474) and **group 6**(t-1.650). But **group 5** and **group 6** had a low mean difference score when compared with **group 4**. **Group 3** was esthetically much better when compared to **group 4**(t-2.457) and statistically significant ($p<0.05$). But **group 5**(t-0.836) and **group 6**(t-1.219) showed statistically insignificant values as the mean difference values were similar and they were esthetically same. **Group 5**(t-3.414) and **group 6**(t-4.194) were esthetically better than **group 4** as their values were highly significant ($p<0.001$). Though **group 5** and **group 6** showed statistical insignificance, their mean score was relatively low when compared to other groups. Hence they both have similar esthetics match and were more appealing. The results under yellow light also favored **group 1**, **group 5** and **group 6** than other groups.

Under UV light, **group 1** showed statistically insignificant values with **group 3**(t-0.873), **group 4** (t-1.984), **group 5**(t-0.423) and **group 6** (t-0.423) which showed that all groups have similar esthetic appearance. But with **group 2**, it was statistically significant ($p<0.05$) and less esthetic than **group 1**. **Group 2** was almost esthetically similar with **group 3**(t-2.098) and **group 4**(t-0.577) as they were statistically insignificant. But **group 5**(t-3.380) and **group 6**(t-3.944) were esthetically better than **group 2** and they were statistically highly significant ($p<0.001$). **Group 3** showed statistically insignificant values with **group 4**(t-1.785), **group 5**(t-1.048) and **group 6**(t-1.189). But **group 5** and **group 6** had low mean difference score when compared with **group 4**. **Group 5**(t-3.666) and **group 6**(t- 4.858) were more esthetically better than **group 4** as the values were highly significant ($p<0.001$). **Group 5** and **group 6** showed statistical insignificant values, as their mean score was relatively less, which infers that they both esthetically match each other. The results showed that **Group 1, group 5** and **group 6** were better than others under UV light.

Based on the results obtained from the study, which was a randomized control trial, the following inferences were made. **Group 1, group 5** and **group 6** were esthetically superior when compared to **group 2, group 3** and **group 4**.This explains that single shade technique was better when compared to the dual shade technique[30] which can be attributed to the presence of multiple hues[31] in same syringe. Also 3M was better than DENTSPLY and Coltene Whaledent esthetically under all light sources. But contrastingly **group 6** using dual shade technique showed promising results as it had a single hue and chroma for both enamel and dentin shades respectively. **Group1 [**(Ceram –X-Mono) used for single shade technique] having multiple hue in same syringe also showed superior results compared to the dual shade counterparts. This could be validated by the fact that it had a superior chameleon effect compared to the other brands. Teeth vary in their degree of translucency. More aged teeth have less translucency and appear duller than its younger counter part. Failure to assess the thickness of enamel, dentin and the degree of translucency may also lead to the shade mismatch, which often is the reason for poor esthetics with the dual shade systems.

Summary and Conclusion

Modern composite systems are either very simple with few shades or very complex with an arry of shades. Hence, this study aimed to compare the optical integration of single shade technique and dual shade technique subjectively.

36 extracted teeth having B2 shade were selected and a Class IV defect was simulated involving mesio incisal edge. Composite materials from 3 different manufacturers were taken (12 teeth in each) Viz: 3M ESPE, Coltene /Whaledent and Dentsply. From each manufacturer 2 composite brands were taken according to techniques used, one for single shade technique and another for dual shade technique. Groups were classified as **Group 1**: Ceram –X –Mono M2 (Mono Shade, Dentsply), **Group 2**: Ceram –X –Duo D2 +E1 (Dual Shade, Dentsply), **Group 3:** SYNERGY NANO FORMULA –B2/A2, (Mono shade, Coltene/Whaledent), **Group 4**: SYNERGY D6 universal duo-shade Nano composite- DENTINE-A2/B2 + ENAMEL –UNIVERSAL (Dual shade, Coltene/Whaledent, Altsatten/Switzerland), **Group 5**: Filtek Z250-B2, (Mono shade, 3M ESPE) and **Group 6**: Filtek Z350 XT- B3 body shade + B2 enamel (Dual shade, 3M ESPE). Teeth were restored accordingly and stored in distilled water to rehydrate for 2 weeks. Photographs were taken under four different light sources (natural day light, white light, yellow light and UV light). Five independent evaluators scored each photograph using Modified EVRSAM score. Mean scores were analyzed with One- way ANOVA (composite resin brands under different light conditions) and Student t -test (between the different composite resin brands). Group 1, group 5 and group 6 had more esthetics, appealing match and appearance when compared with group 2, group 3 and group 4 which explains mono shade technique is better when compared with the dual shade technique.

Hence from this study it can be inferred that

1. Mono shade technique is better than dual shade technique.
2. More time is needed when using more advanced dual shade systems compared with simple systems.
3. Single hue system achieved better optical integration than multiple hue systems.
4. More over the final outcome of the restoration also depends on the histological features of the tooth, age of the patients, the composite brand used, methods of shade selection, light sources used for shade selection and the clinician's skills.

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